STATE OF CALIFORNIA GRAY DAVIS, *Governor*

PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
SAN FRANCISCO, CA 94102-3298

July 23, 2002

TO: RAILROAD CORPORATIONS AND OTHER INTERESTED PARTIES

SUBJECT: DRAFT RESOLUTION AUTHORIZING ADOPTION OF GUIDELINES FOR THE USE OF FOUR QUADRANT GATES IN CONNECTION WITH THE INSTALLATION OF FOUR QUADRANT GATE SYSTEMS AT HIGHWAY RAIL-GRADE CROSSINGS IN THE STATE OF CALIFORNIA

This is a *draft* resolution (SX-41) of the Consumer Protection and Safety Division. It will be on the August 22, 2002, Commission meeting agenda. The Commission may vote on this resolution, or it may postpone a vote until later.

When the Commission votes on the resolution, it may adopt all or part of it as written, amend or modify it, or set it aside and prepare a different resolution. Only when the Commission acts does the resolution become binding.

Interested parties *may* submit comments on the draft resolution. An original and two copies of the comments, with certificate of service, should be submitted to:

Michael Robertson
Consumer Protection and Safety Division
Rail Crossing Engineering Section
505 Van Ness Avenue, 2nd Floor
San Francisco, CA 94102

Comments must be *received* by the Consumer Protection and Safety Division by August 12, 2002. Parties must serve a copy of their comments on all persons on the Service List attached to the draft resolution on the same date that the comments are submitted to the Division. Comments shall be limited to 5 pages in length. They shall focus on factual, legal or technical errors in the proposed resolution.

Late-submitted comments will ordinarily be rejected. However, in extraordinary circumstances a request for leave to submit comments late may be filed. An accompanying declaration under penalty of perjury shall be submitted setting forth all the reasons for the submission.

Reply comments may be submitted five days after the comments are received and shall be limited to identifying misrepresentations of law or fact contained in the comments of other parties. Replies shall not exceed five pages in length, and shall be submitted and served in the manner as comments.

Sincerely,

/s/ RICHARD CLARK
Richard Clark, Director
Consumer Protection and Safety Division

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Consumer Protection and Safety Division
Rail Engineering Safety Branch
Rail Crossings Engineering Section

RESOLUTION SX-41
Date: August 22, 2002

R E S O L U T I O N

RESOLUTION SX-41 AUTHORIZING ADOPTION OF GUIDELINES FOR THE USE OF FOUR QUADRANT GATES IN CONNECTION WITH THE INSTALLATION OF FOUR QUADRANT GATE SYSTEMS AT HIGHWAY-RAIL GRADE CROSSINGS IN THE STATE OF CALIFORNIA.

Summary

Highway-rail grade crossing warning gates are currently the most effective standard warning devices. Some motorists, however, drive on the wrong side of the road to get around the railroad gates, resulting in railroad-vehicle collisions.

Commission Resolution SX-12 authorized a 12- month test by the Los Angeles County Metropolitan Transportation Authority (MTA) of an experimental four quadrant railroad crossing gate system at the 124th Street joint grade crossing of the MTA light rail system, Long Beach Blue Line and Union Pacific Railroad Wilmington Branch in the unincorporated Willowbrook area of Los Angeles County. This experimental four quadrant gate has been in operation since October 1998. The results of the test have been favorable. MTA and other agencies and railroads, such as the Los Angeles to Pasadena Gold Line, the Alameda Corridor East and the Union Pacific Railroad, have expressed interest in installing four quadrant gates at additional locations throughout California.

Commission Resolution SX-31 authorized a rule change to General Order (GO) 75-C, added Section 6.71 to allow the use of four quadrant gates, and revised

Section 10 to require Commission approval before performing crossing upgrades.

This resolution authorizes adoption of Guidelines for the use of Four Quadrant Gates in connection with the installation of four quadrant gate systems at highway-rail grade crossings in the state of California.

Background

Gate run-around is a persistent safety problem at highway-rail grade crossings that have already been upgraded with automatic gate-type warning devices. Impatient drivers sometimes drive on the wrong side of the road to circumvent the gates and beat the train. This is a very dangerous and illegal activity that may result in serious injuries or fatalities. A four quadrant gate installation is designed to prevent motorists from driving around the gates. The results of field tests indicate that this measure may be potentially effective in deterring "gate jumping."

Four quadrant gates are currently implemented at several grade crossings across the United States, Europe and Asia. The actual installation characteristics differ among locations. Variables include exit gate failure modes, use of vehicle detection systems, use of medians, escape routes, interconnectivity with train control systems, skirts, and gap width between gate tips.

On April 6, 2000, the Commission amended GO 75-C to incorporate the use of four quadrant gates in California.

The Guidelines for the use of Four Quadrant Gates were developed by the California Technical Rail Advisory Committee's Subcommittee on Four Quadrant Gates. The guidelines were the result of numerous workshops in which all interested private and public parties attended and discussed relevant issues pertinent to the implementation of four quadrant gate systems.

Discussion

The availability of four quadrant gate systems at highway-rail grade crossings allows one more safety system that can be considered in the course of reviewing highway-rail grade crossing safety.

The purpose of the Guidelines for the use of Four Quadrant Gates is to provide uniform guidance for implementation and configuration of four quadrant gates, as authorized under Commission GO 75-C, to enhance the level of safety at highway-rail grade crossings.

The draft Resolution of the Consumer Protection and Safety Division in this matter was mailed to the parties in accordance with Pub. Util. Code § 311(g)(1 Comments were filed on _____, and reply comments were filed on _____.

Findings

1. Tests results from trial installations (as authorized by Commission Resolution SX-12) of four quadrant gates indicate that, when properly installed and maintained, they can be effective in deterring motorists from driving around gates.

2. Commission Resolution SX-31 authorized a rule change to GO 75-C, adding Section 6.71 to allow the use of four quadrant gates, provided this measure is acceptable to the local jurisdiction, affected railroad or rail transit agency, and other interested public agencies and individuals. It also revised Section 10 to require Commission approval before performing crossing upgrades.

3. The Guidelines for the use of Four Quadrant Gates were developed to serve as uniform guidance in order to clarify the elements that should be addressed by an applicant who is seeking authority to implement four quadrant gates at a highway-rail grade crossing in California.

4. Commission staff has reviewed this proposal.

5. Staff recommends that this resolution be adopted.

Therefore, IT IS ORDERED that:

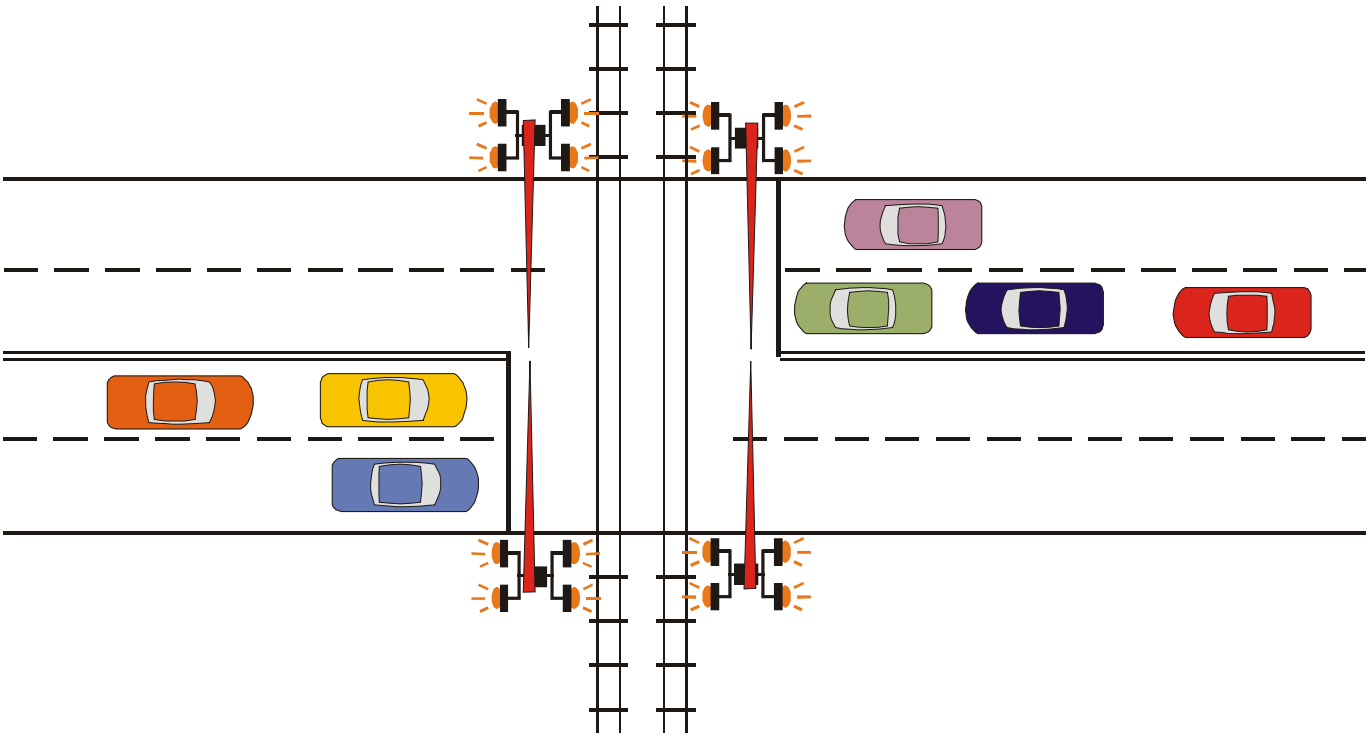
The Guidelines for the use of Four Quadrant Gates, prepared by the California Technical Rail Advisory Committee's Subcommittee on Four Quadrant Gates, be adopted by the California Public Utilities Commission for guidance in the use and implementation of four quadrant gates in the state of California.

This resolution is effective today.

I certify that the foregoing resolution was duly introduced, passed, and adopted by the Commission at its regularly scheduled meeting on _____. The following Commissioners voted favorably thereon:

WESLEY M. FRANKLIN
Executive Director

GUIDELINES FOR THE USE OF FOUR QUADRANT GATES



Prepared by the California Technical Rail Advisory Committee (CALTRAC)

Subcommittee on Four Quadrant Gates

August 2002

Purpose

The purpose of these guidelines is to provide guidance for implementation and configuration of four quadrant gates at highway-rail grade crossings as authorized under PUC General Order No. 75-C. These Guidelines for the Use of Four Quadrant Gates are applicable to all modes of rail including freight, passenger, commuter, light rail, and streetcars.

Goal

The goal of these guidelines is to clarify the elements that should be included in any application seeking authority to install four quadrant gates. .

Background

Gate run-around is a persistent safety problem at highway-rail grade crossings are equipped with automatic gate-type warning devices. Drivers using the highway portion of the crossing sometimes drive on the wrong side of the road in attempting to circumvent the gates and beat the train. This is very dangerous and illegal activity that may result in serious injuries and/or fatalities.

The installation of four quadrant gates is one measure that may be used to minimize these types of grade crossing collisions. Under normal operations four quadrant gates restrict access to the track crossing area prior to the arrival of a train, thus discouraging potential gate violators from driving around the gates.

Four quadrant gates are currently implemented at several grade crossings across the United States, and in Europe and Asia. The actual installation characteristics differ among locations. Variables include exit gate failure modes, use of vehicle detection systems, use of medians, escape routes, interconnectivity with train control systems, skirts, and gap between gate tips.

On April 6, 2000, the PUC adopted General Order No. 75-C to permit the use of four quadrant gates in California where there is a signed agreement between the roadway authorities and the affected railroad or rail transit agency.

Definition of Terms

Gate

An active railroad crossing protection device with an extended arm that lowers to restrict vehicular traffic from crossing the railroad tracks as defined in Section 6.7 of PUC General Order No. 75-C.

Entrance Gate
Gates mounted on the right side of the roadway centerline as defined in Section 6.71 of PUC General Order No. 75-C. (See Figure 1)

Exit Gate
Gates mounted on the left side of the roadway centerline as defined in Section 6.71 of PUC General Order No. 75-C. (See Figure 1)

Track Crossing Area
The track crossing area is the area between the crossing gates and extending the entire width of the roadway right-of-way. (See Figure 1)

Four Quadrant Gates

Four quadrant gates consist of two exit gates used in combination with standard entrance gates. The additional gate arms, combined with standard entrance gates, restrict access to the track crossing area.

Three Quadrant Gates

Three quadrant gates are a variation of four quadrant gates, consisting of two entrance gates and one exit gate. They can also consist of a gate on the left turn vehicular movement at the highway-railroad grade crossing. Crossing geometrics may indicate the need for other configurations of gates, such as five quadrant gates or more. (See Figure 2)

Vehicle Presence Detection System

The system detects the presence of vehicles crossing in the track crossing area. Various forms of vehicle detection are available. The vehicle presence detection system is designed to detect a vehicle in the track crossing area and allow it to exit. The system can be integrated into a four-quadrant gate application to detect the presence of vehicles in the highway-rail grade crossing.

Median Island

A median island as used herein is any effective means of discouraging vehicles from crossing the centerline of a road. (See Figure 3)

Light Rail Transit (LRT)

A mode of urban transportation employing light rail vehicles (LRV) capable of operating on surface streets in mixed traffic, in a semi-exclusive right-of-way, or in an exclusive right-of-way.

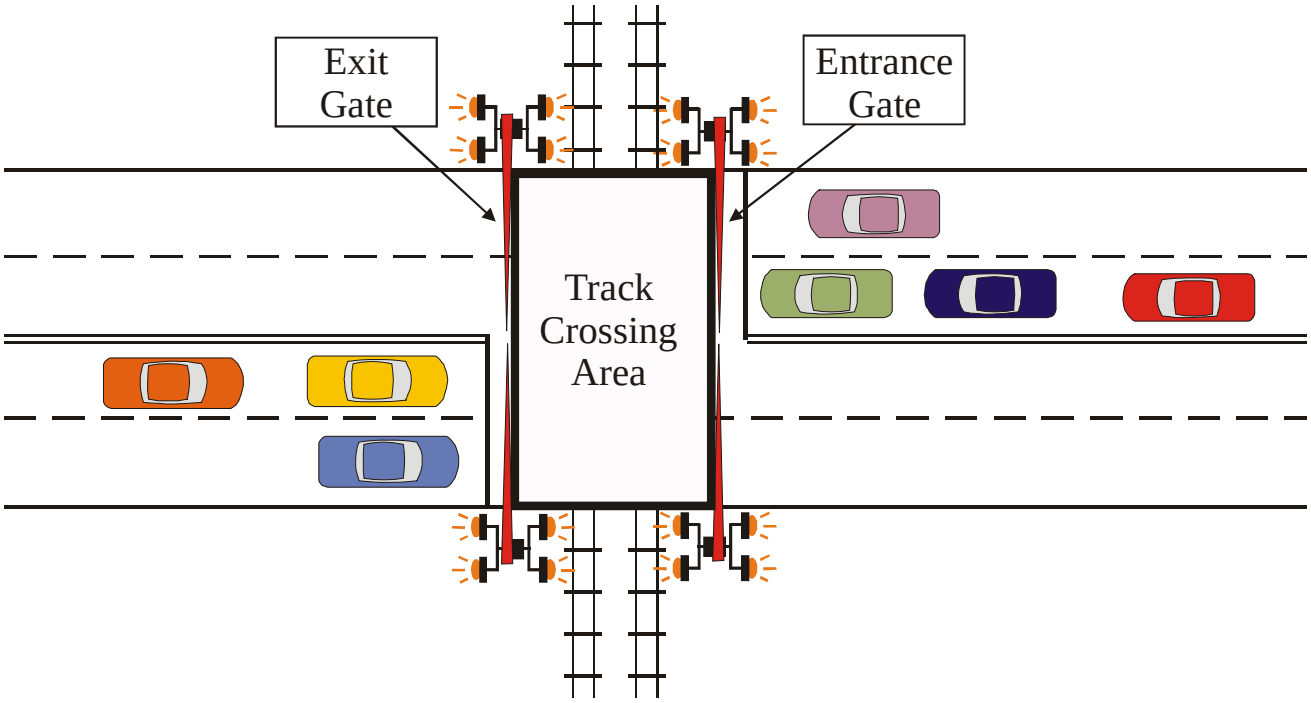


Figure 1 – Four Quadrant Gate System

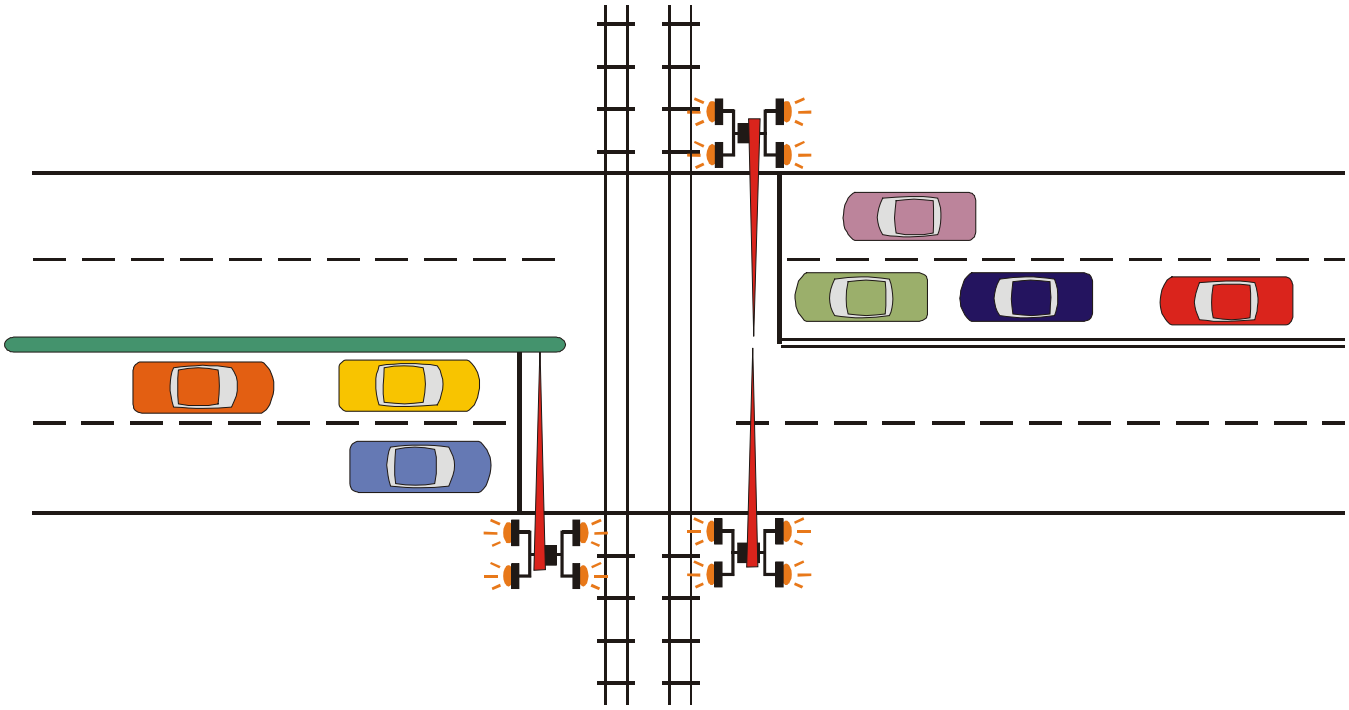


Figure 2 – Three Quadrant Gate

Factors to be Considered for the Design and use of Four Quadrant Gates

Four quadrants gates may be considered at crossings where there is a known or anticipated hazard related to motor vehicles driving around lowered crossing gates and where other solutions that could mitigate this hazard cannot be reasonably implemented.

The most effective means of limiting the potential hazard of motorists driving around lowered crossing gates is through crossing closure and grade separation. Median barriers of adequate size and length on all approaches to the crossing have also proven to be an effective deterrent to gate jumping. Paired one-way streets with full width gates in the direction of travel are another option that should be explored. The diagnostic team should consider these kinds of solutions first.

The American Railway Engineering and Maintenance Association (AREMA) has guidelines for evaluating potential four-quadrant gate projects. In 2001 AREMA added four quadrant gates to its "Recommended Guidelines for the Application of Highway – Rail Grade Crossing Warning Devices", Part 3.1.5 of AREMA's *Communication and Signal Manual of Recommended Practices.* The AREMA guidelines, which include a schematic "decision tree", recommend a sequence of findings and decisions a diagnostic team should make in evaluating any crossing. Before a diagnostic team considers any proposal for four-quadrant gates, the team should have completed a site evaluation and engineering study similar to that described in Section B of Part 3.1.5.

For an existing grade crossing, the potential hazard related to motor vehicles driving around lowered crossing gates can be documented from accident history. Some data is available from FRA's accident database and from the CPUC's Annual Reports as well as photo surveillance programs operated by local jurisdictions. Other possible sources of information include near hit reports compiled by railroads, transit operators and local law enforcement agencies.

For a new grade crossing or an existing one where there are significant changes being planned, the potential hazard related to motor vehicle driving around lowered crossing gates should be based on engineering judgment. However, experience indicates that the following factors are often associated with an increase in the likelihood of motorists driving around lowered gates and should

be considered:

- Long gate down times that may make certain motorists more inclined to avoid the waiting time by driving around the lowered gates;
- Excessively long or inconsistent advance warning times;
- Wide or skewed crossings, typically with one or more tracks, that make the s-turn maneuver around the lowered gates easier to complete; (See Figure 4)
- Streets or alleys running parallel to the tracks and immediately adjacent to the tracks that allow motorists on the parallel streets to more easily drive around the lowered gates, especially where the intersections with the parallel streets are not controlled by traffic signals; (See Figure 5)
- Limited visibility for motorists of approaching trains, due either to obstructions that block the view or skewed crossing geometry;
- Limited sight distance for LRT operators;
- Frequent occurrence of two trains at the same time or nearly at the same time which causes the gates to be held down;
- Joint use corridor with multiple train modes that may travel at different speed through the crossing; and
- Passenger stations adjacent to the grade crossing.

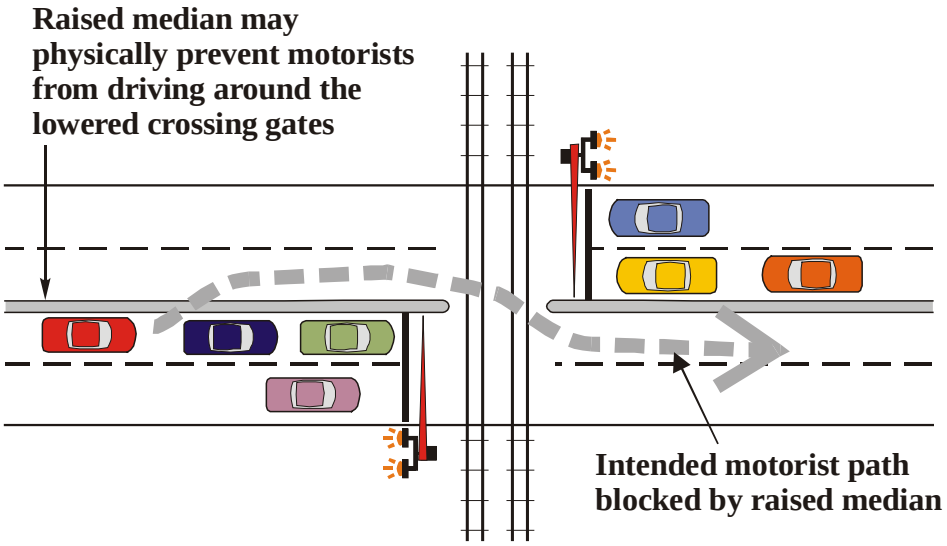


Figure 3 – Raised Median Treatment

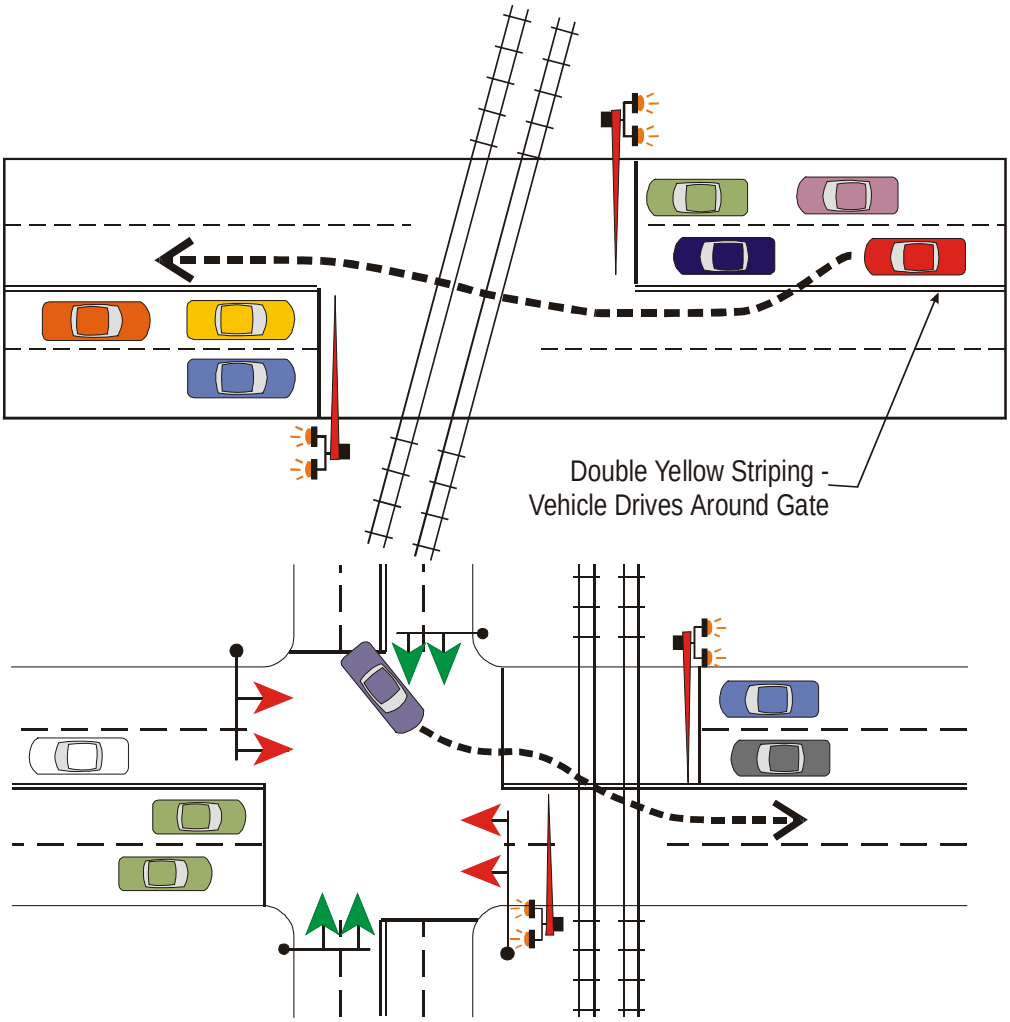


Figure 4 – Drive Around at Skewed

Figure 5 – Drive Around from Parallel Street

The CPUC has implemented changes to General Order 75-C that specify requirements for the installation of four quadrant gates at highway-railroad intersections in the State of California. One of the concerns associated with the use of four quadrant gates is the possibility that motorists could be trapped in the track area behind lowered crossing gates, unable to exit from the track area and at risk of being hit by the approaching train. This hazard can be mitigated to some degree by implementing a time delay in lowering the exit gates, as called for by the CPUC. In addition, the CPUC has concluded that a track area vehicle detection system should be installed as part of a four-quadrant gate system, subject to the recommendations of a diagnostic team review of the crossing and an engineering study performed by the railroad or local road agencies.

Track area vehicle detection should be used at any crossing equipped with three quadrant gates or other configuration where it is possible for a motor vehicle to enter the track area and be trapped by lowered entrance and exit crossing gates.

Vehicle presence detection should be used at all LRT grade crossings equipped with four quadrant gates where the LRT operator sight distance of the crossing is not adequate.

For any crossing where four quadrant gates are being considered, an engineering study should be conducted. The engineering study should be sufficiently detailed to establish track area vehicle detection requirements, track area vehicle detection technology, exit gate delay times, and train approach times. Traffic queuing studies may be applied where there are signalized intersections in the vicinity of the crossing, in order to assess the likelihood of motorists being queued back onto the tracks and the expected queue lengths and dissipation rates for traffic backed up into the track area. A more detailed discussion of the scope of and technical approach to be used for the engineering study is presented elsewhere in this report.

The engineering study and hazard analysis to determine the need for vehicle presence detection at grade crossings equipped with four quadrant gates should consider the following factors:

- Roadway width
- Trackway width (and multiple tracks)
- Queuing from adjacent intersections, driveways, or at-grade crossings,
- Grade Crossing Geometry
- Adequate LRT operator sight line to the crossing
- Motorist Behavior

Where it is determined that vehicle presence detection system is required based on the diagnostic team review and engineering study, the vehicle presence detection system should be designed and implemented with the following characteristics:

1. Ability to detect all motor vehicles, including all passenger motor vehicles, school buses, and trucks but not including motorcycles, bicycles, and shopping carts, within the limits of the track area bounded by:
    a. Alignment of the entrance and exit gates, when lowered; and
    b. Edge of street pavement or traveled way.

    The ability to detect motor vehicles shall be verified by an acceptance test program, as determined by the engineering study and agreed to by the CPUC.

2. Ability to provide “occupied/not occupied” indications to the railroad exit gate down control circuits as follows:
    a. Not occupied indications when the track area is clear and the exit gates may be started down.
    b. Occupied indications when there is a motor vehicle in the track area and the exit gates need to be held up in order to allow the motorist to exit from the track area.

c. Occupied and not occupied indications as required to verify the operation of the vehicle presence detection system and to verify that the ability to provide the occupied indication are operational.
d. Occupied indications when a vehicle presence detection system malfunction is detected.

The occupied/not occupied indications should be generated to control the operation of both exit gates at the same time ("non directional") but may be implemented for each exit gate separately ("directional"), when recommended by the engineering study. When implemented for each exit gate separately, separate occupied indications are needed for the exit gate down control circuits.

3. Ability to verify, not less often than one time each time that the crossing gates are called down, that the vehicle presence detection system is functioning and able to detect vehicle presence in the track area.

   When it is determined that the vehicle presence detection system is not functioning, the system should default immediately to an occupied condition so that the exit gates are held in the up position and should generate an alarm or warning message to the agency responsible for the system. The exit gates should be held in the up position until the cause of the malfunction has been determined and the vehicle presence detection system has been restored to normal operation.

4. Ability to verify each time that the crossing gates are called down, that the occupied indication is functioning.

   When it is determined that the ability to generate an occupied indication is not functioning, the system should default immediately to an occupied condition, if possible, and generate an alarm or warning message that is unique or clearly different from other alarms or warning messages. The occupied condition should be maintained, if possible, until the cause of the malfunction has been determined and the vehicle presence detection system has been restored to normal operation.

5. Ability to not generate false occupied indications, more often than minimum threshold values to be determined by the engineering study, as the result of the following conditions:
   a. Train detected in the track area.
   b. Hi-rail vehicle detected in the track area.
   c. False activation of the vehicle detection system.
   d. Motor vehicles located outside of, but immediately adjacent to, the track area (outside of the lowered crossing gate arm).
   e. Motorcycles, bicycles, and shopping carts.

6. Ability to operate under battery backup power or to default immediately to an occupied condition when external power is lost, based on the results of the engineering study.

7. Vehicle presence detection logic shall be implemented on a programmable controller. The controller should incorporate a display that continuously shows the status of all system controller inputs and outputs, including track area vehicle detects. The controller should be able to monitor its own operation continuously and generate an alarm or warning message in the event that a malfunction is detected. The front panel display shall also show alarm and system error codes required for troubleshooting a system malfunction.

8. Track area vehicle detection system components, including the controller where the track area vehicle detection logic is implemented, shall meet the applicable national and local engineering standards for these type of components.

Operation of Gates

Exit Gates

The exit gate mechanisms shall be designed to fail in the up position in accordance with Section 6.71 of PUC General Order No. 75-C. In addition the following operational procedures should apply:

- If an exit gate fails or breaks, the Railroad Control Center or Dispatch Center should be notified of such a failure either via a communications system or through established Rules and Procedures of the railroad responsible for gate maintenance.
- If a broken entrance gate arm is detected, the exit gate should be raised and remain in the up position until the entrance gate has been repaired.

Delay in Exit Gates

In accordance with Section 6.71 of PUC General Order No. 75-C the exit gates shall be delayed an appropriate interval after the entry gates have started down. The interval shall be based on a crossing-specific review by the railroad, local jurisdiction and regulatory agencies. Some of the factors that should be included in establishing the interval are: angle of the crossing, width of the crossing, available storage space between the gates and the train envelope, proximity of downstream traffic signalized intersections, condition of crossing surface, speed of vehicular traffic at crossing and type of predominant vehicles (trucks, hazmat, school buses, etc) using the crossing. It is important to note that achieving the "appropriate" delay time at a four quadrant gate crossing that has a reliable vehicle presence detection system is less

significant than it is at a four quadrant gate crossing that does not have such a system. And finally, an "excessive" gate delay time may not serve the purpose of the four-quadrant gate system.

Event Recorders

An event recorder should be installed at crossings equipped with four quadrant gate systems. The following events should be recorded as a minimum:

- Time crossing warning is activated
- Time entrance gates start down
- Time entrance gates are fully horizontal
- Time exit gates start down
- Time exit gates are fully horizontal
- Time island circuit is occupied

The above events should be stored in the event recorders memory and be able to be downloaded for analysis. The events should be stored for the latest 24-hour period prior to the download time.

Public Education

Public Outreach Program

In an effort to inform and educate the public about four quadrant gates, a public education and awareness program should be developed. The target audience should include residents, businesses, schools, community groups and emergency service providers (fire stations, hospitals/paramedics, police) within at least a half-mile radius of the crossing where the four quadrant gates will be installed. The program should be developed and implemented cooperatively with the railroad, local agency and regulatory agencies. Requirements for Four Quadrant Applications to the PUC

In addition to filing a formal application with the PUC, as per California Public Utilities Code Sections 1201 to 1205, and General Order No. 75-C, the following information and actions will be required for the PUC staff to make a recommendation on any four- quadrant installation request.

1. Applicant will need to contact the local PUC representative, affected railroad and / or rail transit agency, the agency(ies) having jurisdiction over the roadway, and schedule a field diagnostic meeting to determine the following:
    a. Can the crossing be closed? If not, why not?
    b. Can the crossing be grade separated? If not, why not?
    c. Can medians be constructed, or existing medians lengthened, to discourage drivers from driving in the wrong direction around entrance gates?

2. If it is determined that the above quad gate alternatives are not feasible then the applicant will need to provide the following information:
    a. Accident History: Train-vehicle accidents, Accidents in which motorists drove around the gates.
    b. Risky behavior: Near misses. Records or history of near misses at a crossing. Observations of motorists engaging in risky behavior at a crossing, particularly driving around the gates. All sources must be clearly identified and creditable (i.e.: law enforcement, railroad, and public works personnel).
    c. Prior history and effectiveness of photo enforcement.
    d. Specific geometric concerns:
        i. Diagonal / skewed crossings
        ii. Driveways and parallel roads in near proximity to tracks
        iii. Wide crossings with multiple tracks
        iv. Sight distance problems
        v. Mixed operations
    e. Specific traffic concerns that may warrant the installation of quad gates
        i. Queuing on tracks
        ii. One way streets
        iii. Traffic volumes
    f. Multiple train modes that may warrant the installation of quad gates:
        i. Multiple tracks
        ii. Slow trains
        iii. Train frequency
        iv. Adjacent passenger train stops
        v. Mixed operations
    g. If the crossing has high speed trains

h. If additional R/W will be required

3. Applicant will need to submit an executed railroad(s)/operator-local agency agreement setting forth the terms for the design, construction, and maintenance of the proposed quad gate system, or other documentation that establishes that the request is acceptable to the local jurisdiction, the railroad(s) and/or transit operator, and other interested public agencies and parties.

Recommended Items to be Included in Four Quadrant Gate Agreements

An agreement for the design, construction, operation and maintenance of a four-quadrant grade crossing gate system, between a railroad, and /or transit agency, and an agency having jurisdiction over the street, road or highway involved, may be similar in format to existing agreements used for two-quadrant gate installations and other crossing improvements. Agreements should be negotiated among all parties involved and may include the following:

1. Shortnames - The parties to the agreement should be identified and a shortname defined for each.

2. Recitals - A summary of events that has led to the agreement to install a four-quadrant gate system.

3. Definition of Terms - Define terms and acronyms. If definitions used in the agreement are found elsewhere, reference the technical source(s) where the definitions exist: Code of Federal Regulations, CPUC General Order 75-C, Caltrans Traffic Manual, etc.

4. Diagnostic Observations & Analysis – Provide the rationale for the proposed four-quadrant gate system.

5. Final Design - The agreement should be clear as to which party will be responsible for the design of the four-quadrant gate system including: responsibility for overall coordination of the design effort, design of unique system elements, decisions about advanced warning time, change intervals, track clearance intervals, assignment of design costs, milestones, schedule for design activities, etc.

6. Construction - The agreement should be clear as to which party will be responsible for the construction of the four-quadrant gate system. The responsibilities include: overall coordination of the construction effort (including costs, rights-of-entry, flagging, inspection and insurance), testing leading to the start-up of the system, documentation, certification, system safety oversight plan, construction of roadway,

sidewalks, curb and gutter, milestones, schedule for construction activities, etc.

7. Operation & Maintenance – Once the four-quadrant gate system is complete, the agreement should be clear as to which party will be responsible for operating and maintaining the crossing, vehicle detection systems, exit gate controllers, maintenance costs etc. The agreement should comply with local, state and federal code requirements including Title 49, Parts 212 and 234 of the Code of Federal Regulations, General Order 75-C, and General Order 72-B of the California Public Utilities Commission.

8. Other Sections – Include any mutual hold-harmless agreements, indemnification clauses, a term for the agreement, provisions for termination of the agreement, amendments, a section naming persons or officers by level of authority authorized to receive notices and communications, successors, etc.

9. Signatures – Provide signature lines for persons authorized by the parties to execute agreements and for approval of the form of the agreement by their attorneys along with a date line for each.

10. Exhibits – Identify any attachments to the agreement by a unique number or letter.

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